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ABSTRACT

This paper discusses the different levels of decision-making regarding media selection and technology use in distance education, and suggests a set of criteria and procedures that are practical yet rigorous. Interactivity is one of the main criteria proposed, and the value and meaning of interaction and interactivity in a distance education context are discussed. It is noted that there are many forms of interaction including feedback on performance, the relationship between teacher and student, the relationship between students, and the interaction between the student and the instructional materials. Interaction with instructional materials also takes many forms based on the medium selected for instruction and the way in which the medium is used. For example, the reader's response to text-based instruction is different from the response to information presented on computers or educational programs on television. It is argued that two-way communication technologies such as audiographics and audio, video, and computer networking are becoming popular in conventional teaching institutions because they require little change in teaching behavior from traditional face-to-face teaching. It is concluded that a combination of technologies will provide a balance between conventional teacher-dependent education and the isolated distance education student. (7 references) (DB)

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INTERACTIVITY AS A CRITERION FOR MEDIA SELECTION IN DISTANCE EDUCATION

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INTERACTIVITY AS A CRITERION FOR MEDIA SELECTION IN DISTANCE EDUCATION

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ABSTRACT

Academic models of media selection are not really appropriate for distance education, and the more pragmatic approaches that have been adopted are not usually rigorous enough to ensure the most appropriate mix of media. This paper discusses the different levels of decision-making regarding media and technology in distance education, and suggests a set of criteria and procedures that are practical yet rigorous. Interactivity is one of the main criteria proposed, and the paper discusses the value and meaning of interactivity in a distance education context.

Introduction

There has been a rapid expansion in the range and types of technologies available to distance educators. To the more traditional technologies of print, broadcast television, radio, and audio-cassettes can be added the following new technologies:

- electronic publishing
- telephone teaching and audio conferencing
- audio-graphics
- video-cassettes
- satellite and cable TV
- computer-assisted learning
- electronic mail and computer conferencing
- video conferencing
- video-discs and CD-ROM

With increased choice comes increased difficulty of decision-making. In general, media selection has until recently been restricted mainly by the limited availability of media in students' homes, or the high costs of providing reception technology in local centres. Media selection has been influenced or modified sometimes by administrative and political convenience, in the sense of services such as broadcasting being available - or made available with government encouragement.

However, with increased student accessibility to a wider range of media, and pressure from politicians and administrators to use technology to increase access or reduce costs, there is a desperate need for some rigorous yet practical procedures for making appropriate decisions in this area. Unfortunately, there is a lack of generally agreed criteria for media selection in distance education, and even more fundamentally, a lack of appropriate theory or procedures. While there are numerous academic books on media selection in education, they do not in general suggest approaches that are either practical or relevant to distance education.

Elsewhere (Bates, 1989) I have suggested some key factors that need to be taken into account when deciding on the use of technology for teaching. These can be summarised by the acronym:

A C T I O N S

A ccess: where will students learn: home, work, local centres?

C osts: capital and recurrent; fixed and variable

T eaching functions: presentational requirements of the subject; required teaching and learning approaches

I nteraction and user-friendliness: what kind of learning does this technology encourage? Do students and teachers require a great deal of training to use this technology?

O rganisation: what changes in organisation will be required to facilitate the use of a particular technology?

N ovelty: to what extent will the 'trendiness' of this technology stimulate funding and innovation?

S peed: how quickly and easily can material be up-dated and changed? How quickly can new courses be produced using this technology?

These are listed roughly in order of importance.

I do not wish to dwell on all seven criteria here, but I do want to discuss the fourth, which is the theme of this conference.

Interaction : what does it mean?

Interaction is frequently discussed as being 'a good thing' in education, without its meaning ever being clearly defined. In fact, the meaning varies a great deal, depending on the particular theory of learning that is assumed by the person using the term.

Most theories of learning suggest that for learning to be effective it needs to be active; in other words the learner must respond in some way to the learning material. It is not enough merely to observe or read; learners have to do something with the learning material. Thus they may need to demonstrate (if only to themselves) that they have understood, or they may need to reprocess new material to incorporate it with existing knowledge, or to apply the new knowledge they have

acquired successfully to new situations. Feedback is considered an important component of interaction. Feedback provides learners with knowledge of results, to demonstrate that they have learned correctly, or takes the form of a reaction from another person, which provides an indication of how well the learner has learned.

Media differ considerably in the ways in which they encourage interaction. Many arguments about the value of media in distance education, and the extent to which they can or should replace face-to-face or human interaction, are often based on confusion and misunderstanding about the contexts in which interaction takes place. In effect there are two rather different contexts for interaction: the first is an *individual*, isolated activity, and that is the interaction between a learner and the learning material, be it text, television or computer program; the second is a *social* activity, and that is the interaction between two or more people *about* the learning material. It is important to note the difference: *both* kinds of interactional context are necessary for learning, and both need careful examination.

The loneliness of the long-distance learner

There is a myth of distance learners being isolated students living in a remote cabin or hut miles from the nearest civilisation, and more importantly, miles from the nearest educational institution. While this may be true for an important minority, by far the greatest number of open and distance learners live within half-an-hour's travel time to an educational institution offering a similar level of education. There is an even greater myth that students in conventional institutions are engaged for the greater part of their time in meaningful, face-to-face interaction with their teachers. In fact, in most post-secondary education, this kind of interaction is quite rare. The fact is that for both conventional and distance education students, by far the largest part of their studying is done alone, interacting with text books or other learning media. The difference is that for distance learners, this fact is acknowledged by the designers of the teaching materials, who often take steps to build opportunities for interaction into the learning materials. The aim is to *simulate* a face-to-face conversation between teacher and student. Holmberg (1983) has argued that:

> 'the character of good distance teaching resembles that of a guided conversation aiming at learning... the distance-study course and the non-contiguous communication typical of distance education are seen as the instruments of a conversation-like interaction between the student on the one hand and the tutor counsellor... on the other.'

I shall describe later how this is done through different media.

Learning as a social activity

Social interaction may be of three types in open and distance learning:

- interaction between the learner and the originator of the teaching material;
- interaction between the learner and a tutor, who mediates between the original material and the learner, by providing guidance or assessment;
- interaction between the learner and other learners.

The first kind of interaction is relatively rare in distance education, but we shall see that it is becoming more common with the use of interactive technologies. The second has been the most common, but has in the past been mainly done through correspondence via the mail service, although in addition, many institutions have tried to provide face-to-face tutorials when numbers or resources have permitted. The last is possibly the most important form of interaction for many students, but it has tended to be neglected in distance education, at least until recently, except where students have been fortunate enough to attend local centres or summer schools.

Note that in *all* three types, interaction can take place without face-to-face contact; in other words, even inter-personal interaction can be at a distance, via the mail service or through technologies such as the telephone or computer-based electronic mail. In the area of social interaction, then, we need to differentiate between interaction which is remote or face-to-face, and also interaction that is in real time or asynchronous. In other words, social interaction is not necessarily time or place dependent, or even instructor-dependent if a mediating tutor or peer groups are used.

The quality of interaction

However, also important is the quality of the interaction and feedback. A great deal of nonsense is talked about interaction with regard to media. Much of the most useful interaction between a learner and the learning material is covert - perhaps best described as thinking. A well-written book or stimulating television programme may well encourage a high level of interaction in the learner, by stimulating hard thinking, without any apparent overt actions. Similarly, learners can easily find

ways to beat the machine, not by thoughtfully responding to the questions posed by the computer, but by second-guessing the pattern of pre-determined, multiple-choice answers, or by random guessing until the correct answer is found.

One way of evaluating the quality of interactivity is to ask what kinds of thinking it is likely to stimulate in the learner, and whether this is appropriate for the task at hand. For instance, does the activity merely encourage and reward 'correct' responses, i.e. rote learning, or does it encourage the higher levels of thinking, such as those suggested by Gagné (1977), of synthesis, analysis, evaluation, etc.?

Similarly, feedback can be very simple, merely providing correct answers to straightforward questions; or it can be much more complex, suggesting a variety of alternative responses, and ways to evaluate between them. One way of evaluating feedback is to examine the extent to which it provides flexibility for dealing with the learner's response to activities. Does it provide merely 'yes/no' information as to whether the learner has responded correctly; does it provide remedial activities, e.g. further information or reading, if the answer is not rated correct or adequate; or does it engage the learner is some form of discussion or dialogue about the quality of the learner's response? For instance, does it allow the learner to develop or test an argument or a pattern of thinking as a result of interaction with a tutor or learning material? How does it handle an original response not anticipated by the instructor? It is this latter quality of feedback which is more easily handled by the intervention of a teacher or tutor, and is less easily provided by machines.

Interaction with learning materials

As already stated, a great deal of learning is an isolated activity between a student and learning material. In the past, print was the main medium through which students accessed learning materials, but in recent years television and computers have become increasingly important as sources of learning materials. In this section, I wish to examine the ways in which interaction can be encouraged through the use of each medium, and in particular how each medium encourages different forms of interaction, and in turn how this has important consequences for learning.

Print

In the past, the main form of learning material has been in printed form, such as text books, journal articles, distance education course units. All forms of reading require interaction between the reader and the text. Iser (1978) states that:

> '[Reading] sets in motion a whole chain of activities that depend both on the text and on the exercise of certain basic human faculties. Effects and responses are properties neither of the text nor of the reader; the text represents a potential effect that is realized in the reading process.'

Iser points out that the meaning of the text is something that the reader has to assemble, leading to what Iser calls an 'aesthetic response': 'although it is brought about by the text, it brings into play the imaginative and perceptive faculties of the reader.'

Iser here is discussing a reader's response to a work of literature, which may of course be different from a distance learning text both in its objectives and its form. In another context, it would be useful to analyse the various devices or techniques that authors use to stimulate or encourage interaction by readers. However, the important point here is that a text is not a 'neutral' object; its meaning depends on the interpretation of the reader, whether it is a work of great literature or a car mechanic's manual. Therefore, if the reader is to obtain meaning from a text, there has to be an interaction. What differentiates distance learning texts from other kinds of printed material is a deliberate attempt to structure explicitly a student's response to the material. This may be done in one of several ways, some of which are listed below:

- explicit objectives
- headings (which act as advanced organisers)
- self-assessment questions within the text
- activities - and 'model' responses
- summaries
- examination or assessment questions
- model answers to exam questions.

Print can be designed so that it is densely-packed with information. This has several benefits: a great deal of information can be covered in a relatively cost-effective manner; it can also handle extremely abstract concepts, thus lending itself to advanced levels of education. Print can also be both very precise or deliberately ambiguous. Alternative explanations or approaches can be handled, but only in a sequential manner. Print therefore does allow students to develop higher level skills of interpretation, synthesis and evaluation, as well as comprehension. It is not surprising then that print is still the main medium in higher education, and is suitable for approaches based on cognitive learning.

However, a major weakness of print is providing feedback for questions that have a variety of acceptable responses. Another weakness is that students can easily go to the printed 'feedback', where answers or 'discussion' of the activity is provided, without actively engaging in the exercise. Feedback through print is also less appropriate for more practical forms of learning requiring the development of social or psycho-motor skills.

Therefore print can and often does suggest a wide range of activities for learners, and can also provide feedback. However, learners can still avoid the mental effort required to work through an activity by merely turning to the correct answers, and print provides a very limited range of feedback.

Computers

Most forms of information that can be presented through print can also be presented through computers. Thus cost and accessibility are more important criteria in choosing between print and computers than the form of presentation required. In addition, and at a price, computers can also provide animation and simulation, in the latter case enabling students to respond to 'what if...?' questions.

One of the main strengths of computers is the ease with which they allow learners to interact with the learning material. Computers can encourage learners to respond to learning material through keyboard or graphics and get feedback on their performance; the computer can also use that information to guide learners to the next appropriate step in their learning. Computers thus provide learners with much greater overt interaction than other media.

However, a major weakness of most current computer-assisted learning material is the difficulty of handling a variety of possible interpretations or even different ways of expressing the same correct answer, despite word-recognition and flexible spelling facilities. It is much more difficult for a computer to provide good quality feedback when there are no simple 'right/wrong' answers, but where different interpretations or responses are permissible or even desirable.

For this reason, computers lend themselves better to more behaviouristic approaches to teaching, where 'unchallengeable' facts or procedures are to be learned. It is not surprising then that computer-assisted learning is more common in training and vocational education than in higher education. This may change as artificial intelligence techniques are applied to computer-assisted learning, but these programmes are likely to be expensive to develop and will require powerful machines, making them less appropriate for distance education students.

Television

Television is the richest of the three media, in terms of its density of information, in that it can combine all the major forms of symbolic representation: words, pictures, movement, sound, and 'real-time' representation of events. Television can also of course be used merely to relay a lecture, a talking head with simple graphics. It is important then to distinguish between television which exploits its full range of presentational qualities (which I will describe as 'high quality' television), and television which is merely another way of delivering the lecture format at a distance (which I will describe as 'televised lectures').

High quality television has certain presentational advantages over other media, in that it can represent events and concepts that would be impossible to do for distance learners in a practical way by other means (e.g. scientific experiments requiring complex equipment; field visits to different countries; examples of complex inter-personal behaviour - see Bates, 1984, for a full listing of the unique teaching characteristics of television). Furthermore, because of its richness of ways of presenting information, high quality television lends itself to ambiguity, and hence individual interpretation. Thus television can be particularly useful for dealing with more open-ended concepts, where there are no right or wrong answers, but where a variety of interpretations are not only acceptable but desirable as a teaching goal.

However, students often have great difficulty in interacting with television, for a number of reasons. The extent to which learners are prepared to interact with television is likely to be

influenced by their non-educational use of that medium. Salomon (1983) found that Israeli children learned more from Sesame Street television programmes than American children, despite the fact that television had been available to Israeli children for only two or three years. He found that Israeli children considered television to be a more 'serious' medium than American children, and were therefore prepared to put in greater mental effort to learning from television. On the other hand, American children rated television an 'easy' medium compared with print, no doubt associating television with entertainment, and books with school. There is a tendency then for learners who have not been educated or trained to use television as a serious learning medium to respond extremely passively or non-analytically to educational television.

Secondly, prevailing broadcast professional ideologies about what constitutes 'good' television can conflict strongly with educational approaches that would encourage interaction (see Bates, 1984, for a fuller discussion of this issue). For instance, to keep viewers watching, broadcast television is continuous, and uses techniques which discourage the 'interruption' of the flow of the programme. By its nature broadcast television cannot be interrupted unless recorded. Even educational or training programmes that are never intended for broadcasting, however, are usually made in a continuous sequence, using broadcast formats such as documentary-style. Techniques that would encourage student interaction, such as clear stopping points, built-in questions and activities for viewers, short segments, etc., are rarely found in educational television.

This of course is not an 'inherent' characteristic of television that cannot be changed. Some experimentation in designing video materials that encourage overt interaction can be found at the British Open University (see Crooks, 1988). However, even when such techniques are built into the production of the programme, the difficulty of providing good feedback on learners' responses to the material remains. Indeed, Durbridge (1982) found that learning best occurred from video materials in a group context, where students could test out their interpretations on tutors and/or other students.

There is a great deal of work going into the development of interactive video (i.e. computer-controlled video discs) and multi-media (the development of computer animation and graphics combined with sound, using CD-ROM and computers), because these provide ways to increase the interactivity of learning through visual materials.

However, their ultimate value for distance education will depend on two factors: not only reducing the cost of both equipment and more importantly the cost of development of materials; but also the

ability of such technologies to provide the rich range of interaction and feedback required to allow for different interpretation of materials, as well as for providing correct answers and remedial programming. The danger is that the restrictions on the quality of feedback imposed by students having to respond through a pre-programmed computer will counteract the pedagogic benefits of analysis and interpretation available through video.

Interaction and feedback illustrate very well the point that to some extent media are inter-changeable. What matters is the way the teaching material is designed, and the objectives of the teaching, rather than the medium used. Nevertheless, it is more difficult or at least less common for 'high quality' learning activities and feedback to be handled through some media compared with others.

Two-way communication and interaction

A perceived weakness of the older technologies, such as print and broadcast television and radio, was that they were one-way technologies, good for delivering large quantities of information to large numbers of students, but not good for interaction between student and teacher. We have also seen that despite the power of computers to provide certain kinds of interaction, human tutors are still the most effective way to deal with learning and teaching that requires interpretation and individual analysis. One reason why many distance educators are increasingly interested in some of the newer technologies such as audio-graphics, audio-, video- and computer-networking is their potential for two-way communication, thereby allowing the student to interact directly and flexibly with the teacher or other students, even if at a distance.

There are several issues which should affect the decision to use two-way communications technologies. The first is the relationship between fixed and variable costs, and student numbers.

Print and broadcasting have relatively high fixed production costs, but very low delivery and variable costs. Thus it costs the same to broadcast a television programme to one as to a million students; but producing the programme is very expensive. Thus broadcast television is best used when the number of students or viewers targeted for the programme is large.

'Real-time' distance teaching, through inter-active live or video-recorded television broadcasts, and/or computer-conferencing, combined with set reading from text books and journal articles, can dramatically reduce the high 'front-end' costs of specially designed print-based courses, for

courses with small student numbers, and can also increase student interaction and allow for flexibility in up-dating course material.

The 'production' costs of two-way communications technologies are primarily those associated with the time the teacher puts in and the technology needed to create conferencing - a telephone bridge, computer conferencing software such as CoSy; the delivery costs are primarily those concerned with technologies needed by the student, and the line costs associated with delivery. Both the production and delivery costs of two-way communications technologies are initially low (except for full two-way video conferencing, which is generally far too expensive for most distance education applications); however, costs vary with student numbers: the more students, the more tutors required, if high levels of two-way communication are to be maintained. Similarly, transmission or line costs increase in proportion to the number of students. Thus two-way communications are more suited in economic terms to courses with low numbers of students.

The second issue is more difficult, but is associated with the quality of presentation. One reason why these two-way technologies are becoming popular in conventional teaching institutions is because they require very little change in the behaviour of the teaching staff from their normal face-to-face teaching.

However, for off-campus or distance teaching students, the use of these two-way communications technologies can create certain problems. Most two-way teaching media involve live or spontaneous contributions from the teacher. Where presentations are in real time and/or live, the time and opportunity for student communication is strictly controlled. Audio and video conferencing require the physical presence of a student at both a fixed time and often a fixed place other than the home. Furthermore, when the teaching is in 'real time', and ephemeral, the student is heavily dependent on understanding the presentation and discussions as they happen, and on taking good notes or on a good memory.

One way in which two-way communication media reduce production costs is by making the teacher almost instantaneously available, without the need for a great deal of preparation, thus reducing the time needed from highly-paid subject experts. However, one of the great contributions of distance teaching institutions has been to raise the quality of distance teaching material. This is a result of a great deal of preparation time and team work. High quality teaching materials are particularly important where students have a variety of educational backgrounds and experience of study, and are especially important where entry to courses is open to all.

Thus a number of rather difficult criteria have to be met with 'live' or real-time teaching at a distance: *either* excellent presentation or preparation by the teacher or tutor, *or* good prior subject knowledge and/or study skills from the student; built-in opportunities for ample two-way communication for all students; and some way of providing an easily accessible permanent record of the proceedings. It can be seen that in this respect computer networking has some in-built pedagogic advantages over audio and video conferencing and live interactive TV.

However, for institutions already based on high-cost 'front-end' models, such as autonomous distance teaching universities, not only will existing staff have to be re-trained and in some cases new staff and facilities brought in, but to obtain such savings, major re-organisation of departments and changes to job specifications will also be needed. It is likely then that these two-way communications technologies are more likely to find particular favour in *conventional* institutions wanting to move into off-campus teaching.

What should be even more evident though is that there will often be a need for *both* high quality pre-prepared, permanent material, *and* for two-way communication between students and tutors, to enable students to interact more effectively.

There is also a growing recognition in distance teaching of the importance of adequate local or inter-personal student support, in terms of direct contact with both 'human' counsellors and tutors, and with other students. This is leading to even greater importance being placed on local study or learning centres. This enables more sophisticated two-way equipment to be used than could be used for purely home-based students. However, once again a number of issues arise from the placing of equipment in local centres. Quite difficult policy decisions need to be made about the relative importance of course delivery through local centres or at home, and the extent to which students should be obliged to attend local centres. There are also major cost and security implications in placing equipment in local centres.

Nevertheless, what we are seeing is a 'mid-way' position being established, between the time, place and teacher dependent model of conventional education, and the model of the isolated, but time and place independent, student of 'pure' distance education.

Conclusions

Unfortunately, in educational and cost terms, there is no 'super-technology'; different technologies have different strengths and weaknesses. This means then that a *combination* of technologies is usually the most appropriate decision, although the balance will vary from context to context. It is important to understand the strengths and weaknesses of different technologies for distance teaching. Two-way communications media are valuable tools for distance educators, and will become increasingly so; nevertheless, they are not always appropriate for all the jobs that need to be done. One-way communication media can, with careful design, provide a high level of interaction for students, and so still have an important role to play.

Lastly, while interactivity is an important criterion for selection, media are flexible, and can accommodate interactivity in a variety of ways. For these reasons, cost and accessibility of media are likely to be stronger criteria.

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